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EXAMINER
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ART UNIT	PAPER NUMBER
1756	8

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/963,527	OGATA ET AL.	
	Examiner	Art Unit	
	John Ruggles	1756	

-- The MAILING DATE of this communication app ars on the cov r sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 February 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) *1-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-23* is/are rejected.

7)☒ Claim(s) *16-23* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 September 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *1* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Group II, claims 16-23 in Paper No. 7 in response to the restriction requirement of Paper No. 6 is acknowledged. Accordingly, claims 1-15 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Drawings

The drawings are objected to because: P1 in Figure 4 is mislabeled "cleaning solution" and must be relabeled --developing solution-- to match the description found at lines 6-7 on page 17. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

The drawings are objected to under 37 CFR 1.83(a) because they fail to show: "carrying mechanisms 400" and "controllers...410" as described in the specification at lines 6 and 12-13, respectively, both on page 39. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the remaining claims are directed.

The following title is suggested: --Resist Pattern Forming Method--.

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: "a constant" which should be corrected to --constant-- at line 22 on page 2; "selected from at least for one of" should be --selected from at least one of-- at lines 14-15 on page 5; "at least one of measurement items," should be changed to --at least one of the following measurement items: -- at lines 19-20 on page 6; "surface the exposed" should be corrected to --surface of the exposed-- at line 18 on page 10; "matches" should be "match" at lines 15 and 25 on page 12; "is thus being" should be changed to --has thus been-- at line 1 on page 18 to be in the correct tense, since the developing solution has already been applied; references to appropriate figure numbers have been omitted in their description (e.g., Figure 4 should be inserted at line 5 in reference to the coating unit 3A and Figure 1, 2, and/or 10 should be added at line 23 in reference to the interface unit S2, both on page 19; Figure 3 should be inserted at line 5 on page 21, etc.); "an matching" should be --a matching-- at line 14 on page 23; "un-uniformity" should be corrected to --non-uniformity-- at line 20 on page 23; "amendmentuch" must be changed to --amendment such-- at line 21 on page 30, if this best represents applicant's intention; "processing" should be -

-processing steps-- at line 10 on page 31; and "invaluable" does not make sense in the context of line 8 on page 63 (--invariable-- would make sense in reference to "α" at line 24 on page 62). Note that due to the number of errors, those listed here are merely *examples* of the changes required in the specification and do not represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that it contains no new matter.

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

The abstract of the disclosure is objected to because it has more than 150 words. Correction is required. See MPEP § 608.01(b).

Claim Objections

Claims 16-23 are objected to because of the following informalities: in step (a) of claim 16, "with" should be changed to --by-- at line 18 and "with a" should be changed to --by-- at line 20, both on page 75, to be grammatically correct; in step (b) of claim 16, "and" should be changed to --while-- at line 26 and ", with" should be changed to --by-- at line 26, both on page

75, to be grammatically correct; in step (c) of claim 16, "developing the surface of the substrate with" should be rewritten to --developing the exposed resist on the surface of the substrate by-- at line 2 on page 76, to be proper; also in step (c) of claim 16, "surface the exposed substrate with the resist solution being supplied thereon, then" should be corrected and simplified to -- exposed resist and-- at lines 4-5 on page 76, to be grammatically correct; in step (d) of claim 16, "from;" should be changed to --from:-- at line 11 on page 76; in step (e) of claim 16, "at least for one of" must be corrected to --at least one of-- at line 16 and "amendment;" should be corrected to --amendment:-- at line 17, both on page 76, to be grammatically correct – these same corrections are also needed at lines 5-6 (claim 17) and lines 17-18 (claim 18) on page 77, lines 6-7 (claim 19) on page 78, lines 4-5 (claim 21) and lines 21-22 (claim 22) on page 79, and lines 9-10 (claim 23) on page 80; "from" should be corrected to --to-- at line 22 on page 76 (step (e) of claim 16), line 9 (claim 17) and line 21 (claim 18) on page 77, line 11 (claim 19) on page 78, line 9 (claim 21) and line 27 (claim 22) on page 79, and line 14 (claim 23) on page 80; "to the substrate" should be changed to --on the substrate-- at line 9 (claim 17) and line 21 (claim 18) on page 77, line 11 (claim 19) on page 78, and line 27 (claim 22) on page 79; and "of the" should be deleted at line 1 on page 78 (claim 19). Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claim 21 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The phrase "the default on the surface of the substrate" found at line 2 on page 79 is not enabled by the specification. Instead, lines 16-24 on page 23 describe inspecting for several different types of *defects* either on the resist film (scratch detection), in the resist film (comet detection, development "un-uniformity" or defect), or on the surface of the substrate after etching (pattern defect) (emphasis added). Accordingly, for the purpose of this Office action and in order to advance prosecution of this application, the examiner has interpreted this phrase in claim 21 in light of the specification to mean that measured data of a defect on the surface of the substrate is over a permissible range and within a range of the amendment, as noted and discussed above. However, claim 21 must still be amended in response to this rejection.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 16-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 16 lacks antecedent basis for "the substrate holder" at line 19 on page 75 in step (a) for forming a resist film. Also in step (a) of claim 16 for forming a resist film, it is unclear whether "a base film being formed" found in line 21 on page 75 refers to (1) the resist film or (2) an underlying base film already on the substrate now being coated by the resist. Lines 15-17 on

page 29 of the instant specification state, in part, "...the reflection ratio of the base film measured before resist coating" (emphasis added). This suggests the latter interpretation (2). Also, the phrase "a substrate holder" found at line 22 should be corrected to --the substrate holder--, if this is the same substrate holder as that found at line 19, both on page 75. In step (d) of claim 16, the phrase "an accuracy that the base film matches with a resist pattern" found at lines 11-13 on page 76 is unclear since it is not apparent how such a comparison could be made unless the base film had already been patterned (etched) through the resist, but such patterning or etching of the base film has not yet been claimed (this comparison lacks antecedent basis). Claims 17-23 are dependent on claim 16.

Clam 21 lacks antecedent basis for "the default" found at line 2 on page 79.

Claim 22 lacks antecedent basis for "the heating" and "the temperature for the heating" found at lines 2-3 on page 80.

Claim 23 lacks antecedent basis for "the etched line width" and "the etching" found at lines 6-8 and "the etching gas" at line 17, all on page 80.

Claim 22 is rejected as failing to define the invention in the manner required by 35 U.S.C. 112, second paragraph.

The claim must be in one sentence form only. Note the format of the claims in the patent(s) cited.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 16-19 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Nakayama, et al. (US Patent 5,747,201).

Nakayama teaches a process for controlled forming and treating of a thin film (coating a photoresist (resist) using a spinner (spin coating) at column 8, line 22 and column 12, line 17) on a wafer (substrate) with or without an undercoating (column 9, line 41, base film). This spin coating is understood to encompass supplying a resist solution through a nozzle onto a substrate held by a spinner (horizontal, rotating holder) to spread the resist solution by centrifugal force over the substrate (instant claim 16, step (a)). An optical property measuring system (instant claim 16, step (d) for measuring data) is used to control (instant claim 16, step (e) for amending a set value based on measured data) the rotating frequency (instant claim 16, step (e) for amending rotating speed) of the spinner (during spin coating of the resist), temperature in a baking furnace (instant claim 19 for amending heating of the resist at a predetermined temperature), or (resist) baking time (instant claim 19 for amending heating of the resist for a predetermined time, column 12, lines 12-24). The optical measuring system detects reflectivity of the undercoat (instant claim 16, step (d) and instant claim 17 for measuring the reflection ratio of the base film), resist film thickness (instant claim 16, step (d) and instant claim 18 for measuring resist film thickness), and reflectivity of the resist which are input into an optimum exposure detecting

system to determine the resist index of refraction and obtain an optimum exposure energy composed of the irradiation illuminance (intensity of the ray radiated to the exposing portion (of the resist) on the substrate, instant claim 16, step (e) and instant claims 17-18 for amending exposure intensity) and the exposure time (time period for the exposure, instant claim 16, step (e) and claims 17-18 for amending exposure time) at column 9, lines 36-55. The thickness of resist obtained is used to calculate the variation with time of the resist index of refraction to adjust (amend) the exposure properties (exposure intensity and time). A television camera is connected to an X-Y stage for alignment of a resist-coated wafer (instant claim 16, step (e) for amending alignment of exposing portion of the substrate) in an exposure apparatus controlled by measured optical properties (column 9, line 56 to column 11, line 13). The control of exposure through a patterned reticle (mask) is described at column 13, lines 7-67. This exposure process is understood to encompass disposing the resist coated substrate at the focus point of a lens in the exposing portion having a light source and the lens by radiating a ray of a controlled (predetermined) intensity for a controlled (predetermined) time period, using a predetermined pattern mask (instant claim 16, steps (b) and (e) and instant claims 17-18 for amending the exposure intensity and time period). Developing of the exposed resist is controlled by optical property measurements for the resist (column 8, line 54 to column 9, line 3). The developing is understood to encompass supplying a developing solution of a predetermined temperature onto the exposed resist on the surface of the substrate and leaving the developing solution on the resist for a predetermined time (instant claim 16, steps (c) and (e) and instant claim 17 for amending the developing time period and temperature of developing solution). Nakayama also suggests controlling subsequent etching using optical properties measured before, during, or after film

formation in the abstract, Figure 4, and specifically states this intention in claim 3 (column 15, lines 59-62). Controlling the subsequent etching is understood to encompass etching the substrate by supplying an etching gas of a predetermined composition ratio to the substrate for a predetermined time period (instant claim 22 for amending etching time and gas composition ratio).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 16-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakayama as applied to claims 16-19 and 22 above, in view of Batchelder, et al. (US Patent 4,647,172), further in view of Auda, et al. (US Patent 5,139,904), further in view of Phan, et al. (US Patent 5,985,497), further in view of Lewis, et al. (US Patent 5,308,447), further in view of Sanada (US Patent 5,843,527), further in view of Yoon, et al. (US Patent 5,283,141), and further in view of Bae (US Patent 5,766,809).

While teaching at least one alternative in each of the steps found in claims 16-19 and 22 as pointed out above, Nakayama does not teach all the claimed alternatives in these claims and does not anticipate all the limitations of claims 20-21 and 23. In particular, Nakayama does not specifically teach measuring at least one of the following: base film thickness, line width after developing, accuracy of the base film pattern as compared to the resist pattern, surface defects,

and etched line width. Nakayama also does not specify using one of these measurements for amending at least one of the following: degree of acceleration and/or nozzle position during spin coating, and distance between focus point and substrate during exposure.

Batchelder shows an automatic process for coating a resist on a semiconductor wafer, patterned exposure of the resist, spin developing of the exposed resist pattern, and etching through the developed resist pattern (column 1, line 66 to column 2, line 37). Control (amendment) of the developing time is calculated based on a predictable scaling factor "A" at column 4, lines 22-28. The scaling factor "A" is determined based on microscopic observation (optical measurement) of line widths after developing as shown in Figure 1 and described at column 6, lines 3-15. This process of using variable controlled developing time results in improved consistency of line widths over that using a fixed development time. Similar improvements were also observed with respect to variations in resist coating thickness and resist baking (heating) time (column 6, lines 42-55, instant claim 16, step (d) for measuring resist coating thickness and line width after developing).

Auda describes a method of producing high resolution and reproducible patterns (typically polysilicon ultra-fine lines, in the abstract). A polysilicon layer (base film) on an insulating substrate is coated with a standard photoresist (resist) by conventional techniques as explained in respect to Figure 1A which is described to include spin coating of the resist (column 2, lines 12-33 and column 5, lines 35-40). The resist is imaged with UV radiation through an appropriate (predetermined) mask, post-exposure baked (heated), and developed to produce the resulting structure shown in Figure 2B and described at column 5, lines 40-45. This is followed by either (1) first isotropic etching by high pressure RIE of the resist pattern 17a to

simultaneously reduce the resist thickness and line width to 17a' as shown in Figure 2C, then anisotropic (directional) etching by low pressure RIE of the polysilicon layer (base film) using the reduced resist image and removal of the remaining resist as shown in Figure 2D (column 5, line 50 to column 6, line 13) or (2) first anisotropic (directional) RIE of the polysilicon (base film) using the original (unreduced) resist image as shown in Figure 3B and removal of the remaining resist to form the polysilicon (base film) pattern 16b as shown in Figure 3C, then isotropic RIE of the polysilicon (base film) pattern to simultaneously reduce the base film pattern thickness and line width to form 16b' as shown in Figure 3D (column 6, lines 18-42). The isotropic etching of the resist pattern is optically measured to control (amend) this etching process to obtain the desired resist film thickness and line width (column 6, lines 1-7). It is also paramount that base film etched line width and thickness be accurately monitored (optically measured) during etching to control (amend) etching conditions (etching time for a specified gas composition) at column 6, lines 38-41 and column 7, lines 4-11 (instant claim 16, step (d) and instant claim 17 for measuring base film thickness, instant claim 22 for etching with an etchant gas of a predetermined composition for a predetermined time, and instant claims 22-23 for measuring etched line width).

Phan discloses a method for reducing defects in a semiconductor lithographic process by measuring defects using a scanning electron microscope (SEM) to review and classify the defects into different types and causes (abstract and column 3, lines 26-30). A pattern is formed on a first silicon wafer using a prescribed lithography fabrication processing specification, inspecting (measuring) the pattern for defects, developing an alternative (amended) processing specification to correct for measured defects, using the amended process to form a pattern on a

second silicon wafer, then comparing the first and second patterns, and changing (amending) the lithographic process based on the comparison (resulting from defect measurement, column 2, lines 30-44). The comparison of defect measurements (to determine if the amended process improves yield with a comparable parameter quality) includes those in critical dimensions (CD, understood to encompass base film thickness and etched line width), resist profile (resist film thickness and line width after developing), etch bias (understood to be indicative of the accuracy of an etched base film pattern as compared to a corresponding resist pattern used as an etching mask), and electrical properties is disclosed at column 5, line 63 to column 6, line 5 (instant claim 16, step (d) for measuring base film thickness, resist film thickness, line width after developing, accuracy of base film pattern as compared to resist pattern, and surface defects; instant claim 16, step (e) for amending developing time; instant claim 17 for measuring base film thickness and amending developing time; instant claim 18 for measuring resist film thickness and amending developing time; instant claim 19 for measuring line width after developing and amending developing time; instant claim 21 for measuring defects and amending developing time; and instant claims 22-23 for amending developing time based on etched line width). This comparison and subsequent amendment optimizes the lithography process by reducing defects (column 2, lines 8-9). For optimization by amending properties based on measured defects, Phan discusses changing (amending) developing conditions (specifically, developing time) at column 7, line 46 to column 9, line 3.

Lewis teaches a process of controlled (amended) positioning of developer nozzles 21 and 23 at different distances from the center of rotation over a spinning resist coated article (wafer) based on optical measurements (by photodetectors to measure completion of developing -- could

involve measurement of line width after developing) during the process as shown in Figure 1 and described at column 3, line 45 to column 4, line 55. This is understood to be equivalent to amendment of a nozzle position for resist spin coating based on an optical measurement (e.g., resist film thickness, etc.; instant claim 16, step (d) for measuring resist film thickness; instant claim 16, step (e) for amending nozzle position during spin dispensing or coating; and instant claim 23 for amending nozzle position during spin dispensing or coating). Etching can also be accomplished by a liquid etchant applied to a spinning substrate in much the same controlled manner (by amendment based on a measurement) as spin coating a resist on a substrate or developer on an exposed resist (column 7, lines 55-57). Plasma dry etching can be conducted using optical measuring of etching progress (e.g., by measuring etched line width, etc.) to control (amend) the etching process (e.g., to change gaseous etchant composition ratio, control etching time, etc.) as shown in Figure 5 and described at column 7, line 57 to column 8, line 21 (instant claims 22-23 for measuring etched line width and instant claim 23 for amending etching time and etching gas composition ratio). Temperature of the developer (solution) or, alternatively, an etchant supplied through nozzles 21 and 23 is also controllable (Figures 1-2, column 8, lines 58-62; instant claim 16, step (c) for supplying a developer solution at a predetermined temperature; instant claim 16, step (e) and instant claims 19, 21-23 for amending developer solution temperature). The rotation speed and linear motion of the substrate can be controlled along with a process variation for rotating distribution nozzles to selectively treat only portions of the rotating substrate (column 9, lines 3-12; instant claims 19 and 22 for amending rotation speed of the substrate during resist spin coating). Both the flow rate and direction of individual nozzles can be controlled (column 9, lines 19-21; instant claim 16, step (e) and instant claims 21 and 23

for amending nozzle position during resist spin coating). Developer (solution) or etchant composition can be controlled by selective mixing of plural components in response (amended by) system controllers 55 or 103 as shown in Figures 1 or 2 and described at column 9, lines 21-24 (instant claim 22 for etching by an etching gas having a predetermined composition ratio for a predetermined time period and instant claim 23 for amending the etching gas composition ratio and/or etching time based on measured etched line width). Uniformity is obtained by controlled correction (amendment) for variations (measured) across the surface of a substrate during processing (column 1, lines 9-13 and column 2, lines 18-24).

Sanada discloses a method of spin coating photoresist (resist) on a horizontal substrate (semiconductor wafer, column 1, lines 7-11, column 18, lines 50-52, as shown in Figure 4). Back rinse nozzles 11 remove extraneous resist from the backside (underside) of the substrate and a resist supply nozzle 5 delivers resist to the substrate during coating. Acceleration (increasing rotation speed) applied after beginning centrifugal spreading leads to the curved coating patterns shown in Figures 6C-D, due to inertia of the resist during increasing rotation of the substrate as described at column 20, lines 25-56 (instant claim 16, step (e) for amending rotating substrate degree of acceleration and nozzle position during resist spin coating; instant claims 17-19 and 22 for amending rotating substrate degree of acceleration during resist spin coating). As a result, a desired resist film thickness is formed on the substrate wafer by using a drastically reduced supply of resist solution (column 21, lines 24-26). This reduces cost (because less resist is wasted) and improves throughput for manufacture of semiconductor elements and devices (column 23, lines 43-53). Column 25, lines 48-58 also disclose use of a movable resist

dispensing nozzle, adjustable (amendable) based on resist viscosity, wafer size and surface condition.

Yoon shows a photolithography method and corresponding apparatus controlled (amended) by measuring optical characteristics of the resulting latent image. Adjustment (amendment) means such as a computer 104 adjusts (amends) control parameters according to information obtained from observations (measurements) of latent images by a phase contrast microscope 110 as shown in Figure 1 and described at column 3, lines 8-11. The latent image (characterized by image line width at column 3, lines 58-59) is discernable as changed "optical thickness" in the resist due to changed refractive index in the exposed pattern portions, depending on the length (time) and intensity of exposure (column 3, lines 28-53). The image measurement is alternatively described as occurring while exposure of the resist is actually taking place to provide in-situ monitoring/observation for correction (amendment) of the exposure process (column 4, lines 15-19). As shown in Figure 3 and described at column 4, lines 49-54, the image measurement controls adjustment (amendment) of exposure conditions including numerical aperture, exposure time, wafer position, focus (encompasses distance between focus point and substrate during exposure), and illumination coherence (instant claim 16, step (e) for amending exposure intensity and time, and distance between focus point and substrate during exposure; and instant claim 19 for amending exposure intensity or distance between focus point and substrate during exposure; instant claim 21 for amending exposure intensity or distance between focus point and substrate based on measured line width (to reveal defects); and instant claims 22-23 for amending exposure intensity, exposure time, or distance between focus point and substrate during exposure based on measured line width (understood to

be indicative of line width after etching)). Column 6, lines 52-55 state that the in-situ latent image measurement allows quick adjustment (amendment) of the exposure stepper apparatus for each new mask layer or batch of wafers, without having to develop the exposed resist (shows that measuring the latent image line width is an appropriate substitution for measuring the line width after developing, instant claim 16, step (e) and instant claim 19 for measuring line width after developing).

Bae describes a method for testing an overlay in a semiconductor device for alignment (of substrate exposing portion). An etch layer (base film) is coated on a semiconductor wafer, then etched through a photoresist (resist) film pattern to form outer alignment marks 42 shown in Figures 9-10 and described at column 5, lines 50-60. The first resist is removed, and another resist layer 45 is coated over the marks 42, exposed through a patterned mask (aligned with the etched marks 42 on the substrate), and developed to form an inner mark including an island portion 43 inwardly spaced from the outer marks 42 by a desired width and a land portion 44 to form an overlay measuring mark shown in Figure 10 and described at column 6, line 61 to column 7, line 5. The overlay is then used for an accurate alignment measurement (column 7, lines 6-10) (instant claim 20 for measuring accuracy of base film pattern as compared to resist pattern and amending alignment of the exposing portion of the substrate).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the controlled (amended) photolithographic process based on measured data taught by Nakayama as discussed above with controlled (amended) developing time to obtain improved consistency of line widths after developing as shown by Batchelder; and/or with controlled (amended) etching conditions based on measured base film thickness or accuracy of

etched line width (as compared to the resist pattern) to produce high resolution and reproducible patterns as described by Auda. Anisotropic (directional) etching of the base film using the resist image (pattern) along with line width measurements of the resist pattern and corresponding etched base film as described by Auda would also be expected to provide parameters for resulting control (amendment) of the etching process (instant claim 16, step (d) for measuring accuracy of etched base film pattern as compared to the resist pattern to amend a process parameter and instant claim 23 for measuring etched line width for amending the etching time period and/or etching gas composition ratio). It would also have been obvious to combine the controlled (amended) photolithographic process based on measured data taught by Nakayama, Batchelder, and/or Auda as discussed above with defect correction and reduction (by an amendment based on defect measurement) for optimizing the photolithography process as disclosed by Phan.

Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the controlled (amended) photolithographic process based on measured data taught by Nakayama, Batchelder, Auda, and/or Phan with controlled (amended) dispensing nozzle position (for resist spin coating or developing solution spreading), developer solution temperature, line width after developing, or etching of the substrate (or base film, by amending the etching time and/or the etching gas composition ratio) based on measured resist film thickness or etched line width for resulting uniformity even when surface variations occur during processing as taught by Lewis; and/or with controlled (amended) degree of acceleration during resist spin coating based on measured resist film thickness to achieve reduced cost and improved throughput as disclosed by Sanada. It would also have been obvious to combine the

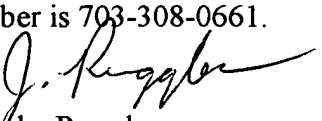
controlled (amended) photolithographic process based on measured data taught by Nakayama, Batchelder, Auda, Phan, Lewis, and/or Sanada as discussed above with controlled (amended) distance between the focus point and the substrate during exposure, exposure intensity, or exposure time based on measured line width (latent image line width substitutes for line width after developing) to allow quick in-situ amendment of exposure conditions, even before developing as shown by Yoon and/or amending alignment of the exposing portion of the substrate based on measured accuracy of the etched base film as compared to the resist pattern for accurate alignment as described by Bae.

Conclusion

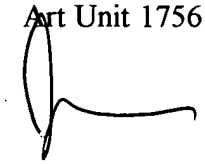
Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 703-305-7035. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.



John Ruggles
Examiner
Art Unit 1756



JOHN A. MCPHERSON
PRIMARY EXAMINER